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Technical Specification

**3rd Generation Partnership Project;
Technical Specification Group Core Network and Terminals;
Diameter based protocols to support
Short Message Service (SMS) capable
Mobile Management Entities (MMEs)
(Release 11)**



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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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1 Scope

The present document defines the Diameter-based interfaces specific to SMS when they are used in conjunction with the "SMS in MME" architecture specified in 3GPP TS 23.272 [2]. It comprises:

- the Diameter application for the S6c interface between the HSS and the SMS-GMSC or the SMS Router and between the SMS-GMSC and the SMS Router;
- the Diameter application for the SGd interface between the MME and the SMS-IW MSC or the SMS-GMSC or the SMS Router and between the SMS-GMSC and the SMS Router.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 23.272: "Circuit Switched (CS) fallback in Evolved Packet System (EPS); Stage 2".
- [3] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS)".
- [4] 3GPP TS 29.272: "Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol".
- [5] 3GPP TS 29.229: "Cx and Dx interfaces based on the Diameter protocol; Protocol details".
- [6] IETF RFC 2234: "Augmented BNF for Syntax Specifications: ABNF".
- [7] IETF RFC 3588: "Diameter Base Protocol".
- [8] IETF RFC 5516: "Diameter Command Code Registration for the Third Generation Partnership Project (3GPP) Evolved Packet System (EPS)".
- [9] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".
- [10] 3GPP TS 29.173: "Location Services (LCS); Diameter-based SLh interface for Control Plane LCS".
- [11] 3GPP TS 33.210: "3G security; Network Domain Security (NDS); IP network layer security".
- [12] IETF RFC 4960: "Stream Control Transport Protocol".
- [13] ITU-T Recommendation E.164: "The international public telecommunication numbering plan".
- [14] 3GPP TS 29.329: "Sh Interface based on the Diameter protocol; Protocol details".
- [15] 3GPP TS 29.336: "Home Subscriber Server (HSS) diameter interfaces for interworking with packet data networks and applications".
- [16] 3GPP TS 23.003: "Numbering, addressing and identification".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

ABNF	Augmented Backus-Naur Form
IANA	Internet Assigned Numbers Authority
IP-SM-GW	IP Short Message Gateway
MWD	Message Waiting Data
RP	Relay layer Protocol
RP-MTI	RP Message Type Indicator
RP-SMEA	RP SME-Address
RP-UI	RP User Information
SM RL	Short Message Relay Layer
SMS-GMSC	Gateway MSC for SMS
SMS-IWMSC	Interworking MSC for SMS

4 General

4.1 Introduction

The SMS in MME architecture is described in 3GPP TS 23.272 [2] and has specified the reference points S6c and SGd. The clause 4 addresses Diameter aspects which are common to both S6c and SGd.

4.2 Use of Diameter Base protocol

The Diameter Base Protocol as specified in IETF RFC 3588 [7] shall apply except as modified by the defined support of the methods and the defined support of the commands and AVPs, result and error codes as specified in this specification. Unless otherwise specified, the procedures (including error handling and unrecognised information handling) shall be used unmodified.

4.3 Securing Diameter messages

For secure transport of Diameter messages, see 3GPP TS 33.210 [11].

4.4 Accounting functionality

Accounting functionality (Accounting Session State Machine, related command codes and AVPs) shall not be used on the S6c and SGd interfaces.

4.5 Use of sessions

Between the MME or the HSS and the SMS-IW MSC or the SMS-GMSC or the SMS Router and between the SMS-GMSC and the SMS Router, Diameter sessions shall be implicitly terminated. An implicitly terminated session is one for which the server does not maintain state information. The client shall not send any re-authorization or session termination requests to the server.

The Diameter base protocol includes the Auth-Session-State AVP as the mechanism for the implementation of implicitly terminated sessions.

The client (server) shall include in its requests (responses) the Auth-Session-State AVP set to the value NO_STATE_MAINTAINED (1), as described in IETF RFC 3588 [7]. As a consequence, the server shall not maintain any state information about this session and the client shall not send any session termination request. Neither the Authorization-Lifetime AVP nor the Session-Timeout AVP shall be present in requests or responses.

4.6 Transport protocol

Diameter messages over the S6c and SGd interfaces shall make use of SCTP as specified in IETF RFC 4960 [12] as transport protocol.

4.7 Advertising application support

The MME, HSS, SMS-IW MSC, SMS-GMSC and SMS Router shall advertise support of the Diameter S6c and/or SGd Application by including the value of the application identifier in the Auth-Application-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands.

The vendor identifier value of 3GPP (10415) shall be included in the Supported-Vendor-Id AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands, and in the Vendor-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands.

The Vendor-Id AVP included in Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands that is not included in the Vendor-Specific-Application-Id AVPs as described above shall indicate the manufacturer of the Diameter node as per IETF RFC 3588 [7].

4.8 Diameter Application Identifier

The S6c and SGd interface protocols shall be defined, each, as an IETF vendor specific Diameter application, where the vendor is 3GPP. The vendor identifier assigned by IANA to 3GPP (<http://www.iana.org/assignments/enterprise-numbers>) is 10415.

The Diameter application identifier assigned to the S6c interface application is 16777312 (allocated by IANA).

The Diameter application identifier assigned to the SGd interface application is 16777313 (allocated by IANA).

4.9 Use of the Supported-Features AVP

When new functionality is introduced on the S6c or SGd applications, it should be defined as optional. If backwards incompatible changes can not be avoided, the new functionality shall be introduced as a new feature and support advertised with the Supported-Features AVP. The usage of the Supported-Features AVP on the S6c or S6e applications is consistent with the procedures for the dynamic discovery of supported features as defined in clause 7.2 of 3GPP TS 29.229 [5].

When extending the application by adding new AVPs for a feature, the new AVPs shall have the M bit cleared and the AVP shall not be defined mandatory in the command ABNF.

As defined in 3GPP TS 29.229 [5], the Supported-Features AVP is of type grouped and contains the Vendor-Id, Feature-List-ID and Feature-List AVPs. On the all reference points as specified in this specification, the Supported-

Features AVP is used to identify features that have been defined by 3GPP and hence, for features defined in this document, the Vendor-Id AVP shall contain the vendor ID of 3GPP (10415). If there are multiple feature lists defined for the reference point, the Feature-List-ID AVP shall differentiate those lists from one another.

5 Diameter based S6c interface between HSS and central SMS functions

5.1 Introduction

The S6c interface enables the retrieval of routing information for the transfer of short messages, the report of status of the delivery status of a short message and the alerting of the SMS-SC between the HSS, the SMS-GMSC and the SMS Router as described in 3GPP TS 23.040 [3].

5.2 Procedures description

5.2.1 Send Routing Info for SM procedure

5.2.1.1 General

This procedure shall be used between the SMS-GMSC or the IP-SM-GW and the HSS to retrieve the routing information needed for routing the short message to the serving MSC or MME or SGSN. This procedure is also used between the SMS-GMSC and the SMS Router or the IP-SM-GW, and between the HSS and the SMS Router or the IP-SM-GW in order to enforce routing of the SM delivery via the HPLMN of the receiving MS.

This procedure is applicable to an IP-SM-GW for its SMS Router function when using the S6c interface.

This procedure is used according to the call flows described in 3GPP TS 23.040 [2] clause 10.

Table 5.2.1.1-1 specifies the involved information elements for the request.

Table 5.2.1.1-2 specifies the involved information elements for the answer.

This procedure is mapped to the commands Send-Routing-Info-for-SM-Request/Answer (SRR/SRA) in the Diameter application specified in subclause 5.3.2.

Table 5.2.1.1-1: Send Routing Info for SM Request

Information element name	Mapping to Diameter AVP	Cat.	Description
MSISDN	MSISDN	C	This information element shall be present when the MSISDN exists and shall contain the MSISDN of the user.
IMSI	User-Name (See IETF RFC 3588 [6])	C	This information element shall be present when the MSISDN does not exist and shall contain the IMSI of the user.
Service Centre Address	SC-Address	M	This information element shall contain the Service Centre address .
SM-RP-MTI	SM-RP-MTI	C	This information element shall contain the RP-Message Type Indicator of the Short Message. It is used to distinguish a SM sent to the mobile station in order to acknowledge an MO-SM initiated by the mobile from a normal MT-SM. This information element is formatted according to the formatting rules of address fields as described in 3GPP TS 23.040 [2].
SM-RP-SMEA	SM-RP-SMEA	C	This information element shall contain the RP-Originating SME-address of the Short Message Entity that has originated the SM. This information element shall be present if the SMS-GMSC supports receiving of the two numbers from the HSS. Used by the short message service relay sub-layer protocol it shall be formatted according to the formatting rules of address fields as described in 3GPP TS 23 040 [2].
SRR Flags	SRR-Flags	C	This Information Element contains a bit mask. See 5.3.3.4 for the meaning of the bits and the condition for each bit to be set or not.
SM-Delivery Not Intended	SM-Delivery Not Intended	O	This information element, when present, shall indicate that delivery of a short message is not intended. It further indicates whether only IMSI or only MCC+MNC are requested. This information element may be set by entities that request the service without intending to deliver a short message, and shall be evaluated by the SMS Router and may be evaluated by the HLR.
Supported Features	Supported-Features (See 3GPP TS 29.229 [5])	O	If present, this Information Element shall contain the list of features supported by the origin host.

Table 5.2.1.1-2: Send Routing Info for SM Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Result	Result-Code / Experimental-Result	M	<p>Result of the request.</p> <p>Result-Code AVP shall be used for errors defined in the Diameter Base Protocol.</p> <p>Experimental-Result AVP shall be used for S6c errors. This is a grouped AVP which contains the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. This information element shall contain the result of the operation with an indication of the success / errors.</p> <p>The following errors are applicable in this case:</p> <ul style="list-style-type: none"> - Unknown User; - Service Barred; - Teleservice Not Provisioned; - Absent User; - Facility Not Supported.
IMSI	User-Name (See IETF RFC 3588 [6])	C	<p>This information element:</p> <ul style="list-style-type: none"> - either shall contain the IMSI of the user. - or, if enforcement of routing an SM via the HPLMN of the receiving MS or UE is deployed, shall contain an MT Correlation ID instead of an IMSI when the service is used between SMS-GMSC and SMS Router (see 3GPP TS 23.040 [3] for more information). - or, if the "SM-Delivery Not Intended" Information Element was present in the request with a value of "only MCC+MNC requested", may contain MCC+MNC+dummy MSIN. <p>This information element shall be present in a successful answer.</p> <p>This information element shall be present in an answer from the HSS to the IP-SM-GW, if an Absent User result is returned and the UNRI is not set.</p>
Serving-Node	Serving-Node	C	<p>If the "SM-Delivery Not Intended" Information Element was not present in the request, this information element shall contain the identity of one serving node on which the user is registered. This identity shall either be:</p> <ul style="list-style-type: none"> - the Diameter identity and the Diameter realm of the MME registered for MT SMS plus the E164 number of the MME for MT SMS. - or the ISDN number of the MSC - or the ISDN number of the SGSN, <p>If the "SM-Delivery Not Intended" Information Element was present in the request, this information element may be absent.</p> <p>This information element shall be present in a successful answer.</p>
LMSI	LMSI	C	<p>The HSS shall include the LMSI in a successful response, if the VLR has used the LMSI and if there is the ISDN number of an MSC in the answer.</p>
Additional Serving Node	Additional-Serving-Node	C	<p>This information element, when present shall either contain:</p> <ul style="list-style-type: none"> - the Diameter identity and the Diameter realm of the MME registered for MT SMS plus the E164 number of the MME for MT SMS. - or the ISDN number of the MSC - or the ISDN number of the SGSN. <p>It shall not contain information delivered in the Serving Node information element.</p>
User Identifier Alert	User-Identifier	C	<p>This information element shall contain the MSISDN stored in the HSS, when available.</p>
MWD Status	MWD-Status	C	<p>This Information Element is sent when appropriate and shall contain a bit mask. See 5.3.3.8 for the meaning of the bits.</p>
MME Absent User Diagnostic SM	MME-Absent-User-Diagnostic-SM	C	<p>This information element shall contain the reason of the absence of the user when given by the MME and stored in the HSS</p>
MSC Absent User Diagnostic SM	MSC-Absent-User-Diagnostic-SM	C	<p>This information element shall contain the reason of the absence of the user when given by the MSC and stored in the HSS</p>

SGSN Absent User Diagnostic SM	SGSN-Absent-User-Diagnostic-SM	C	This information element shall contain the reason of the absence of the user when given by the SGSN and stored in the HSS
Supported Features	Supported-Features (See 3GPP TS 29.229 [5])	O	If present, this information element shall contain the list of features supported by the origin host.

5.2.1.2 Detailed behaviour of the SMS-GMSC

The SMS-GMSC shall make use of this procedure to retrieve the routing information needed for routing the short message to the serving MSC or MME or SGSN or for enforcing routing of the SM delivery via the SMS Router of HPLMN.

It shall populate the information elements in the Send Routing Info for SM request according to the table 5.2.1.1-1.

When receiving the Send Routing Info for SM Answer, the SMS-GMSC or the SMS Router shall use the received Diameter address if the SMS-GMSC or the SMS Router transfers the terminating short message over the SGd interface.

5.2.1.3 Detailed behaviour of the HSS

This subclause describes the HSS behaviour when the HSS receives a Send Routing Info for SM request which is not forwarded to an SMS Router or an IP-SM-GW.

The HSS shall check if the user identified by the MSISDN is known; otherwise the HSS shall return an Experimental-Result-Code set to DIAMETER_ERROR_USER_UNKNOWN.

The HSS shall check if a MT SMS Teleservice subscription exists; otherwise the HSS shall return an Experimental-Result-Code set to DIAMETER_ERROR_SERVICE_NOT_SUBSCRIBED.

The HSS shall check if the user is not barred for receiving MT short messages; otherwise, the HSS shall return an Experimental-Result-Code set to DIAMETER_SERVICE_ERROR_BARRED.

The HSS shall check if one or more serving nodes are registered for MT SMS; otherwise, the HSS shall return an Experimental-Result-Code set to DIAMETER_ERROR_ABSENT_USER.

The HSS shall then return a Send Routing Info for SM answer with a Result-Code set to DIAMETER_SUCCESSFUL that shall contain the addresses of the serving nodes which are registered for MT SMS according the following rules:

- if the GPRS indicator is not set, only one serving node address shall be returned according to the SM transfer option where MME is considered as a MSC. The address of the MME, if returned, shall comprise the MME Diameter address and the MME Number for MT SMS.
- if the GPRS indicator is set, two serving node addresses shall be returned of which
 - the SGSN number,
 - either the number of the MSC or the Diameter address and the number of the MME for MT SMS.
- when two serving g nodes addresses are returned, the HSS selects which serving node it will populate in the Serving Node information element and in the Additional Serving Node information elements.

NOTE: MSC and MME cannot be both registered as serving nodes for MT SMS at a given time (cf 3GPP TS 23.272 [2])

If the stored MSISDN number is not the same as the one received in the Send Routing Info for SM request service, the stored MSISDN number shall be included in the message.

5.2.1.4 Detailed behaviour of the SMS Router

When receiving a Send Routing Info for SM request, the SMS Router shall:

- send a Send Routing Info for SM request to the HSS to retrieve the routing information needed for routing the short message to the serving MSC or MME or SGSN;
- if the Send Routing Info for SM answer received from HSS is successful, the SMS Router shall send a Send Routing Info for SM answer to the SMS-GMSC where
 - the SMS router shall populate the same Serving Node and Additional Serving Node fields (i.e AVPs) as the ones it received in the Send Routing Info for SM answer from HSS, but with its own SMS Router number and its own SMS Router Diameter address;
- if the Send Routing Info for SM answer received from HSS is not successful, the SMS Router shall send a Send Routing Info for SM answer to the SMS-GMSC with the same Diameter error result code.

If the SMS Router receives some of the following information elements, User Identifier Alert, MWD Status, MSC Absent User Diagnostic SM, MME Absent User Diagnostic SM, SGSN Absent User Diagnostic SM, it shall transfer them in the Send-Routing Info for SM answer to the SMS-GMSC.

5.2.2 Alert Service Centre procedure

5.2.2.1 General

This procedure shall be used between the HSS and the SMS-IW MSC to indicate that the MS is now recognized by the PLMN to have recovered its operation to allow for an MT SMS delivery. This procedure is used according to the call flows described in 3GPP TS 23.040 [2] clause 10.

Table 5.2.2.1-1 specifies the involved information elements for the request.

Table 5.2.2.1-2 specifies the involved information elements for the answer.

This procedure is mapped to the commands Alert-Service-Centre-Request/Answer (ALR/ALA) in the Diameter application specified in subclause 5.3.2.

Table 5.2.2.1-1: Alert Service Centre Request

Information element name	Mapping to Diameter AVP	Cat.	Description
Service Centre Address	SC-Address	M	This information element shall contain the Service Centre address received from the mobile station.
User Identifier Alert	User-Identifier	M	This information element shall contain <ul style="list-style-type: none"> - the Alert MSISDN when it exists - otherwise the IMSI.
Supported Features	Supported-Features (See 3GPP TS 29.229 [5])	O	If present, this information element shall contain the list of features supported by the origin host.

Table 5.2.2.1-2: Alert Service Centre Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Result	Result-Code / Experimental-Result	M	This information element shall contain the result of the request. The Result-Code AVP shall be used for errors defined in the Diameter Base Protocol. The Experimental-Result AVP shall be used for S6c errors. This is a grouped AVP which contains the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. This information element shall contain the result of the operation with an indication of the success / errors. No errors are defined for this case.
Supported Features	Supported-Features (See 3GPP TS 29.229 [5])	O	If present, this information element shall contain the list of features supported by the origin host.

5.2.2.2 Detailed behaviour of the HSS

The HSS shall make use of this procedure to alert the service centre when the mobile user is active after a short message transfer has failed because the mobile user is not reachable, or when the UE has indicated that it has memory capacity to accept a short message.

It is an operator option to resend an Alert Service Centre request to the SMS-IW MSC if the alert is unsuccessful. The number of repeat attempts and the interval between them is also an operator option. The service centre address should be purged from the MWD list if the alert is consistently unsuccessful.

5.2.2.3 Detailed behaviour of the SMS-IW MSC

When receiving an Alert Service Centre request the SMS-IW MSC shall check whether the service centre address is known. If the service centre address is not valid, then no further action shall be taken.

If the service centre address is valid, the SMS-IW-MSC generates an Alert Service Centre message towards the SMS Centre.

5.2.3 Report SM Delivery Status procedure

5.2.3.1 General

This procedure shall be used between the SMS-GMSC or the IP-SM-GW and the HSS to update the Message Waiting Data in the HSS or to inform the HSS of a successful SM transfer after polling. This procedure is invoked by the SMS-GMSC or the IP-SM-GW.

This procedure is applicable to an IP-SM-GW for its SMS Router function when using the S6c interface.

This procedure is used according to the call flows described in 3GPP TS 23.040 [2] clause 10.

Table 5.2.3.1-1 specifies the involved information elements for the request.

Table 5.2.3.1-2 specifies the involved information elements for the answer.

This procedure is mapped to the commands Report-SM-Delivery-Status-Request/Answer (RDR/RDA) in the Diameter application specified in subclause 5.3.2.

Table 5.2.3.1-1: Report SM Delivery Status Request

Information element name	Mapping to Diameter AVP	Cat.	Description
MSISDN	User-Identifier	M	This information element shall contain the MSISDN of the user when it exists. Otherwise It shall contain the IMSI (i.e. when the user has a MSISDN-less subscription).
Service Centre Address	SC-Address	M	This information element shall contain the Service Centre address .
SM Delivery Outcome	SM-Delivery-Outcome	M	This information element shall contain the causes for setting the message waiting data in the HSS according to the network node(s) used for the SM delivery: <ul style="list-style-type: none"> - MSC - MME - SGSN - IP-SM-GW. At least one cause shall be present. A cause originated from a MSC and a cause originated from a MME shall not be both present. When the cause is Absent User, the Absent User Diagnostic, if available, shall be associated to the cause.
Supported Features	Supported-Features (See 3GPP TS 29.229 [5])	O	If present, this Information Element shall contain the list of features supported by the origin host.

Table 5.2.3.1-2: Report SM Delivery Status Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Result	Result-Code / Experimental-Result	M	This information element shall contain the Result of the request. The Result-Code AVP shall be used for errors defined in the Diameter Base Protocol. The Experimental-Result AVP shall be used for S6c errors. This is a grouped AVP which contains the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. This information element shall contain the result of the operation with an indication of the success / errors. The following errors are applicable: <ul style="list-style-type: none"> - Unknown User; - Message Waiting List Full.
MSISDN-Alert	User-Identifier	C	This information element shall contain the Alert MSISDN of the user if it is different from the MSISDN received in the request.
Supported Features	Supported-Features (See 3GPP TS 29.229 [5])	O	If present, this information element shall contain the list of features supported by the origin host.

5.2.3.2 Detailed behaviour of the SMS-GMSC

The SMS-GMSC shall make use of this procedure if:

- the reason received from the serving node for failure to deliver the message is absent user , unidentified user or SM delivery failure with error cause "UE memory capacity exceeded", and the SC address is not yet included in the MWD set, or
- the reason received from the serving node for failure to deliver the message is absent user, unidentified user or SM delivery failure with error cause "UE memory capacity exceeded", and the corresponding flag in the HSS (as indicated in the information received from HSS) is not set, or
- the reason received from the serving node (MSC/MME or SGSN) for failure to deliver the message is absent user and the absent user diagnostic is different from the absent user diagnostic received from the HSS.

If absent user diagnostic information (see 3GPP TS 23.040 [3]) is received with the absent user error indication then the SMS-GMSC shall relay this information to the HSS.

5.2.3.3 Detailed behaviour of IP-SM-GW

The IP-SM-GW shall make use of this procedure if:

- the reason for failure to deliver the message is absent user, unidentified user or SM delivery failure with error cause "UE memory capacity exceeded", and the SC address is not yet included in the MWD set, or
- the reason for failure to deliver the message is absent user, unidentified user or SM delivery failure with error cause "UE memory capacity exceeded", and the corresponding flag in the HSS (as indicated in the information received in the MAP_INFORM_SERVICE_CENTRE) is not set, or
- the reason for failure to deliver the message is absent user and the absent user diagnostic is different from the absent user diagnostic received from the HSS.

5.2.3.4 Detailed behaviour of the HSS

When receiving a Report SM Delivery Status request the HSS shall check if the user is known.

If the user is not known, the HSS shall return an Experimental-Result-Code set to DIAMETER_ERROR_USER_UNKNOWN.

If it is known, the HSS shall update the Message Waiting data as described in 3GPP TS 23.040 [3]. If the message waiting data is full, the HSS shall return an Experimental-Result-Code set to DIAMETER_ERROR_MWD_LIST_FULL.

If the received MSISDN is different from the stored MSISDN, the HSS shall return the Alert MSISDN.

5.3 Protocol specification

5.3.1 Routing considerations

5.3.1.1 Requests from the SMS-GMSC or the SMS router

5.3.1.1.1 Introduction

The subclauses in 5.3.1.1 specify the use of the Diameter routing A VPs Destination-Realm and Destination-Host over the S6c interface for Diameter command requests from the SMS-GMSC or the SMS router (i.e. for the Send Routing Info for SM and the Report SM Delivery Status procedures).

5.3.1.1.2 Routing from the originating PLMN

If the SMS-GMSC or the SMS router has stored or can obtain the address/name and the home network domain name of the HSS identified by the MSISDN or the IMSI, both the Destination-Realm and Destination-Host A VPs shall be present in the request.

The SMS Router shall use the MCC/MNC values of the PLMN to which it belongs, to build the MCC/MNC based network domain as described in subclause 19.2 of 3GPP TS 23.003 [16] and include it in the Destination-Realm A VP of the request. The request shall then be routed to the next Diameter node.

If the SMS-GMSC can only obtain the MCC/MNC values from the MSISDN or the IMSI, the SMS-GMSC shall use them to build the MCC/MNC based network domain as described in subclause 19.2 of 3GPP TS 23.003 [16] and include it in the Destination-Realm A VP of the request. The request shall then be routed to the next Diameter node.

If the SMS-GMSC cannot obtain the MCC/MNC values from the MSISDN of the user, the SMS-GMSC may forward the request to a Diameter node within the same PLMN, the Destination Realm content being left to the PLMN operator choice. Then:

- if a Diameter node in the routing path inside the PLMN of the SMS-GMSC can obtain the MCC/MNC values of the PLMN to which the user is subscribed to (i.e. when the number portability is resolved in the network of the SMS-GMSC), or
- if, otherwise, the Diameter node can obtain the MCC/MNC values of the PLMN associated to the CC and NDC codes of the MSISDN of the user, then
- the Diameter node shall use them to build the MCC/MNC based network domain as described in subclause 19.2 of 3GPP TS 23.003 [16] and include it in the Destination-Realm AVP of the request. The request shall then be routed to the next Diameter node.

If the MCC/MNC values of the PLMN associated to the CC and NDC codes of the MSISDN or the MCC/MNC values of the PLMN to which the user is subscribed to cannot be obtained in the PLMN of the SMS-GMSC, the request shall be replaced in the PLMN of the SMS-GMSC by an equivalent request routed through a MAP interface (e.g. via an IWF).

NOTE 1: The inter-PLMN routing principle is to reuse the routing based on a MCC/MNC based domain name as used by other Diameter applications such as S6a/d. It is assumed that obtaining the relevant MCC/MNC values from the MSISDN can be achieved in the PLMN to which the SMS-GMSC belongs. Otherwise MAP-based routing is used. This routing principle may be completed with other routing solutions in the future.

NOTE 2: The Number portability resolution in the PLMN of the SMS-GMSC can be handled by an intermediate Diameter agent consulting a Number Portability Database of the Network Portability domain to which the PLMN of the SMS-GMSC belongs.

5.3.1.1.3 Routing in the HPLMN

When the request reaches a Diameter node in the home PLMN of the user and when multiple and separately addressable HSSs have been deployed in the home PLMN, the identity of the HSS that holds the subscriber data for a given user identified by its MSISDN may be retrieved by a user identity to HSS resolution mechanism as described in subclause 5.4.

Consequently, the Destination-Host AVP is declared as optional in the ABNF for all requests initiated by an SMS-GMSC or a SMS Router.

The HSS, when receiving a Send Routing Info for SM request, checks if an SMS Router is configured in the home network or if an IP-SM-GW has been registered for the user. If yes, the HSS shall act as a Diameter proxy and forward the request to the SMS Router or to the IP-SM-GW, by inserting the Diameter address of the SMS Router or of the IP-SM-GW as the Diameter destination address.

If the Vendor-Specific-Application-ID AVP is received in any of the commands, it may be ignored by the receiving node, and it shall not be used for routing purposes.

5.3.1.2 Requests from the HSS

This clause specifies the use of the Diameter routing AVPs Destination-Realm and Destination-Host over the S6c interface for Diameter command requests from the HSS (i.e. for the Alert SC procedure).

If the HSS has stored the address/name of the SMS-SC and the associated home network domain name in the Message Waiting Data of the user, both the Destination-Realm and Destination-Host AVPs shall be present in the Diameter request. Otherwise the routing shall use MAP.

5.3.2 Commands

5.3.2.1 Introduction

This section defines the Command code values and related ABNF for each command described for the S6c interface.

5.3.2.2 Command-Code values

This section defines the Command-Code values for the S6c interface application as allocated by IANA in the IETF RFC 5516 [8].

Every command is defined by means of the ABNF syntax IETF RFC 2234 [6], according to the rules in IETF RFC 3588 [7]. In the case, the definition and use of an AVP is not specified in this document, the guidelines in IETF RFC 3588 [7] shall apply.

NOTE: For this release, the Vendor-Specific-Application-ID is included as an optional AVP in all commands in order to ensure interoperability with diameter agents following a strict implementation of IETF RFC 3588 [7], by which messages not including this AVP will be rejected. IETF RFC 3588 [7] indicates that the AVP shall be present in all proxiable commands, such as those specified here, despite that the contents of this AVP are redundant since the Application ID is already present in the command header. This AVP may be removed in subsequent revisions of this specification, once the diameter base protocol is updated accordingly.

The following Command Codes are defined in this specification:

Table 5.3.2.2/1: Command-Code values for S6c

Command-Name	Abbreviation	Code	Section
Send-Routing-Info-for-SM-Request	SRR	8388647	5.3.2.3
Send-Routing-Info-for-SM-Answer	SRA	8388647	5.3.2.4
Alert-Service-Centre-Request	ALR	8388648	5.3.2.5
Alert-Service-Centre-Answer	ALA	8388648	5.3.2.6
Report-SM-Delivery-Status-Request	RDR	8388649	5.3.2.7
Report-SM-Delivery-Status-Answer	RDA	8388649	5.3.2.8

For these commands, the Application-ID field shall be set to 16777312 (application identifier of the S6c interface application allocated by IANA).

5.3.2.3 Send-Routing-Info-for-SM-Request (SRR) Command

The Send-Routing-Info-for-SM-Request (SRR) command, indicated by the Command-Code field set to 8388647 and the "R" bit set in the Command Flags field, is sent from SMS-GMSC to HSS or SMS Router or from SMS Router to HSS.

Message Format:

```

< Send-Routing-Info-for-SM-Request > ::= < Diameter Header: 8388647, REQ, PXY, 16777312 >
    < Session-Id >
    [ Vendor-Specific-Application-Id ]
    { Auth-Session-State }
    { Origin-Host }
    { Origin-Realm }
    [ Destination-Host ]
    { Destination-Realm }
    [ MSISDN ]
    [ User-Name ]
    *[ Supported-Features ]
    [ SC-Address ]
    [ SM-RP-MTI ]
    [ SM-RP-SMEA ]
    [ SRR-Flags ]
    [ SM-Delivery-Not-Intended ]
    *[ AVP ]
    *[ Proxy-Info ]
    *[ Route-Record ]

```

5.3.2.4 Send-Routing-info-for-SM-Answer (SRA) Command

The Send-Routing-Info-for-SM-Answer command (SRA) command, indicated by the Command-Code field set to 8388647 and the 'R' bit cleared in the Command Flags field, is sent from HSS to SMS-GMSC or SMS Router or from SMS Router to SMS-GMSC.

Message Format

```
< Send-Routing-info-for-SM-Answer > ::= < Diameter Header: 8388647, PXY, 16777312 >
    < Session-Id >
    [ Vendor-Specific-Application-Id ]
    [ Result-Code ]
    [ Experimental-Result ]
    { Auth-Session-State }
    { Origin-Host }
    { Origin-Realm }
    [ User-Name ]
    *[ Supported-Features ]
    [ Serving-Node ]
    [ Additional-Serving-Node ]
    [ LMSI ]
    [ User-Identifier ]
    [ MWD-Status ]
    [ MME-Absent-User-Diagnostic-SM ]
    [ MSC-Absent-User-Diagnostic-SM ]
    [ SGSN-Absent-User-Diagnostic-SM ]
    *[ A VP ]
    *[ Failed-A VP ]
    *[ Proxy-Info ]
    *[ Route-Record ]
```

5.3.2.5 Alert-Service-Centre-Request (ALR) Command

The Alert-Service-Centre-Request (ALR) command, indicated by the Command-Code field set to 8388648 and the "R" bit set in the Command Flags field, is sent from SMS-GMSC or IP-SM-GW to HSS.

Message Format:

```
< Alert-Service-Centre-Request > ::= < Diameter Header: 8388648, REQ, PXY, 16777312 >
    < Session-Id >
    [ Vendor-Specific-Application-Id ]
    { Auth-Session-State }
    { Origin-Host }
    { Origin-Realm }
    [ Destination-Host ]
    { Destination-Realm }
    { SC-Address }
    { User-Identifier }
    *[ Supported-Features ]
    *[ A VP ]
    *[ Proxy-Info ]
    *[ Route-Record ]
```

5.3.2.6 Alert-Service-Centre-Answer (ALA) Command

The Alert-Service-Centre-Answer (ALA) command, indicated by the Command-Code field set to 8388648 and the 'R' bit cleared in the Command Flags field, is sent from HSS to SMS-GMSC or IP-SM-GW.

Message Format

```
< Alert-Service-Centre-Answer > ::= < Diameter Header: 8388648, PXY, 16777312 >
    < Session-Id >
```

```

[ Vendor-Specific-Application-Id ]
[ Result-Code ]
[ Experimental-Result ]
{ Auth-Session-State }
{ Origin-Host }
{ Origin-Realm }
*[ Supported-Features ]
*[ A VP ]
*[ Failed-A VP ]
*[ Proxy-Info ]
*[ Route-Record ]

```

5.3.2.7 Report-SM-Delivery-Status-Request (RDR) Command

The Report-SM-Delivery-Status-Request (RDR) command, indicated by the Command-Code field set to 8388649 and the "R" bit set in the Command Flags field, is sent from SMS-GMSC or IP-SM-GW to HSS.

Message Format:

```

< Report-SM-Delivery-Status-Request > ::= < Diameter Header: 8388649, REQ, PXY, 16777312 >
< Session-Id >
[ Vendor-Specific-Application-Id ]
{ Auth-Session-State }
{ Origin-Host }
{ Origin-Realm }
[ Destination-Host ]
{ Destination-Realm }
*[ Supported-Features ]
{ User-Identifier }
{ SC-Address }
{ SM-Delivery-Outcome }
*[ A VP ]
*[ Proxy-Info ]
*[ Route-Record ]

```

5.3.2.8 Report-SM-Delivery-Status-Answer (RDA) Command

The Report-SM-Delivery-Status-Answer (RDA) command, indicated by the Command-Code field set to 8388649 and the 'R' bit cleared in the Command Flags field, is sent from HSS to SMS-GMSC or IP-SM-GW.

Message Format

```

< Report-SM-Delivery-Status-Answer > ::= < Diameter Header: 8388649, PXY, 16777312 >
< Session-Id >
[ Vendor-Specific-Application-Id ]
[ Result-Code ]
[ Experimental-Result ]
{ Auth-Session-State }
{ Origin-Host }
{ Origin-Realm }
*[ Supported-Features ]
[ User-Identifier ]
*[ A VP ]
*[ Failed-A VP ]
*[ Proxy-Info ]
*[ Route-Record ]

```

5.3.3 AVPs

5.3.3.1 General

The following table specifies the Diameter AVPs defined for the S6c interface protocol, their AVP Code values, types, possible flag values and whether or not the AVP may be encrypted. The Vendor-ID header of all AVPs defined in this specification shall be set to 3GPP (10415).

For all AVPs which contain bit masks and are of the type Unsigned32, e.g. TFR-Flags, bit 0 shall be the least significant bit. For example, to get the value of bit 0, a bit mask of 0x0001 should be used.

Table 5.3.3.1/1: S6c specific Diameter AVPs

Attribute Name	AVP Code	Section defined	Value Type	AVP Flag rules				
				Must	May	Should not	Must not	May Encr.
SM-RP-MTI	3308	5.3.3.2	Enumerated	M, V				No
SM-RP-SMEA	3309	5.3.3.3	OctetString	M, V				No
SRR-Flags	3310	5.3.3.4	Unsigned32	M, V				No
SM-Delivery-Not-Intended	3311	5.3.3.5	Enumerated	M, V				No
MWD-Status	3312	5.3.3.8	Unsigned32	M, V				No
MME-Absent-User-Diagnostic-SM	3313	5.3.3.9	Enumerated	M, V				No
MSC-Absent-User-Diagnostic-SM	3314	5.3.3.10	Enumerated	M, V				No
SGSN-Absent-User-Diagnostic SM	3315	5.3.3.11	Enumerated	M, V				No
SM-Delivery-Outcome	3316	5.3.3.14	Grouped	M, V				No
MME-SM-Delivery-Outcome	3317	5.3.3.15	Grouped	M, V				No
MSC-SM-Delivery-Outcome	3318	5.3.3.16	Grouped	M, V				No
SGSN-SM-Delivery-Outcome	3319	5.3.3.17	Grouped	M, V				No
IP-SM-GW-SM-Delivery-Outcome	3320	5.3.3.18	Grouped	M, V				No
SM-Delivery-Cause	3321	5.3.3.19	Enumerated	M, V				No
Absent-User-Diagnostic-SM	3322	5.3.3.20	OctetString	M, V				No
NOTE 1: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V" indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see IETF RFC 3588 [4]. NOTE 2: If the M-bit is set for an AVP and the receiver does not understand the AVP, it shall return a rejection. If the M-bit is not set for an AVP, the receiver shall not return a rejection, whether or not it understands the AVP. If the receiver understands the AVP but the M-bit value does not match with the definition in this table, the receiver shall ignore the M-bit.								

The following table specifies the Diameter AVPs re-used from existing Diameter Applications, including a reference to their respective specifications and when needed, a short description of their use within this interface.

Any other AVPs from existing Diameter Applications, except for the AVPs from Diameter Base Protocol, do not need to be supported. The AVPs from Diameter Base Protocol are not included in table 5.3.3.1/2, but they may be re-used for this interface.

Table 5.3.3.1/2: S6c re-used Diameter AVPs

Attribute Name	Reference	Comments	M-bit
User-Name	IETF RFC 3588 [7]		Must
MSISDN	3GPP TS 23.329 [14]		
SC-Address	3GPP TS 29.338	It is defined for the SGd interface, see subclause 6.3.3.2	
LMSI	3GPP TS 29.173 [10]		
Serving-Node	3GPP TS 29.173 [10]	See subclause 5.3.3.6	
MSC-Number	3GPP TS 29.173 [10]		
MME-Name	3GPP TS 29.173 [10]		
MME-Realm	3GPP TS 29.173 [10]		Must
MME-Number-for-MT-SMS	3GPP TS 29.272 [4]		Must
SGSN-Number	3GPP TS 29.272 [4]		
Additional-Serving-Node	3GPP TS 29.173 [10]	See subclause 5.3.3.7	
User-Identifier	3GPP TS 29.336 [15]		
SM-Delivery-Failure-Cause	3GPP TS 29.338	It is defined for the SGd interface, see subclause 6.3.3.5	
IP-SM-GW-Name	3GPP TS 29.336 [15]		
IP-SM-GW-Number	3GPP TS 29.336 [15]		
Supported-Features	3GPP TS 29.229 [5]		
Feature-List-ID	3GPP TS 29.229 [5]	See subclause 5.3.3.12	
Feature-List	3GPP TS 29.229 [5]	See subclause 5.3.3.13	
NOTE 1: The M-bit settings for re-used AVPs override those of the defining specifications that are referenced. Values include: "Must set", "Must not set". If the M-bit setting is blank, then the defining specification applies.			
NOTE 2: If the M-bit is set for an AVP and the receiver does not understand the AVP, it shall return a rejection. If the M-bit is not set for an AVP, the receiver shall not return a rejection, whether or not it understands the AVP. If the receiver understands the AVP but the M-bit value does not match with the definition in this table, the receiver shall ignore the M-bit.			

5.3.3.2 SM-RP-MTI

The SM-RP-MTI AVP is of type Enumerated and shall contain the RP-Message Type Indicator of the Short Message. The following values are defined:

- SM_DELIVER (0)
- SM_STATUS_REPORT (1)

5.3.3.3 SM-RP-SMEA

The SM-RP-SMEA AVP is of type OctetString and shall contain the RP-Originating SME-address of the Short Message Entity that has originated the SM. It shall be formatted according to the formatting rules of the address fields described in 3GPP TS 23.040 [3].

5.3.3.4 SRR-Flags

The SRR-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 5.3.3.4./1:

Table 5.3.3.4/1: SRR-Flags

Bit	Name	Description
0	GPRS-Indicator	This bit shall be set if the SMS-GMSC supports receiving of two serving nodes addresses from the HSS.
1	SM-RP-PRI	This bit shall be set if the delivery of the short message shall be attempted when a service centre address is already contained in the Message Waiting Data file
NOTE 1: Bits not defined in this table shall be cleared by the sending entity and discarded by the receiving entity.		

5.3.3.5 SM-Delivery-Not-Intended

The SM-Delivery-Not-Intended AVP is of type Enumerated and shall indicate by its presence that delivery of a short message is not intended. It further indicates whether only IMSI or only MCC+MNC with the following values:

- ONLY_IMSI_REQUESTED (0),
- ONLY_MCC_MNC_REQUESTED (1).

5.3.3.6 Serving-Node

The Serving-Node AVP is of type Grouped. This AVP shall contain the information about the network node serving the targeted user. It is originally defined in 3GPP TS 29.173 [10].

AVP format

Serving-Node ::= <AVP header: 2401 10415>

[SGSN-Number]
 [MME-Name]
 [MME-Realm]
 [MME-Number-for-MT-SMS]
 [MSC-Number]
 [IP-SM-GW-Number]
 [IP-SM-GW-Name]
 *[AVP]

The following combinations are allowed:

- a) SGSN-Number
- b) MME-Name & MME-Realm & MME-Number-for-MT-SMS
- c) MSC-Number
- d) MSC-Number & MME-Name & MME-Realm
- e) IP-SM-GW-Number
- f) IP-SM-GW-Number & IP-SM-GW-Name.

5.3.3.7 Additional-Serving-Node

The Additional-Serving-Node AVP is of type Grouped. This AVP shall contain the information about the network node serving the targeted user. It is originally defined in 3GPP TS 29.173 [10].

AVP format

Additional-Serving-Node ::= <A VP header: 2406 10415>
 [SGSN-Number]
 [MME-Name]
 [MME-Realm]
 [MME-Number-for-MT-SMS]
 [MSC-Number]
 *[AVP]

The following combinations are allowed:

- a) SGSN-Number
- b) MME-Name & MME-Realm & MME-Number-for-MT-SMS
- c) MSC-Number
- d) MSC-Number & MME-Name & MME-Realm

5.3.3.8 MWD-Status

The MWD-Status AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 5.3.3.8/1:

Table 5.3.3.8/1: MWD Status

bit	name	Description
0	SC-Address Not included	This bit when set shall indicate the presence of the SC Address in the Message Waiting Data in the HSS.
1	MNRF-Set	This bit, when set, shall indicate that the MNRF flag is set in the HSS
2	MCEF-Set	This bit, when set, shall indicate that the MCEF flag is set in the HSS.
3	MNRG-Set	This bit, when set, shall indicate that the MNRG flag is set in the HSS
NOTE: Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME.		

5.3.3.9 MME-Absent-User-Diagnostic-SM

The MME-Absent-User-Diagnostic-SM A VP is of type Enumerated and shall indicate the diagnostic explaining the absence of the user given by the MME. The values are defined in 3GPP TS 23.040 [3].

5.3.3.10 MSC-Absent-User-Diagnostic-SM

The MSC-Absent-User-Diagnostic-SM A VP is of type Enumerated and shall indicate the diagnostic explaining the absence of the user given by the MSC. The values are defined in 3GPP TS 23.040 [3].

5.3.3.11 SGSN-Absent-Subscriber-Diagnostic-SM

The SGSN-Absent-User-Diagnostic-SM A VP is of type Enumerated and shall indicate the diagnostic explaining the absence of the user given by the SGSN. The values are defined in 3GPP TS 23.040 [3].

5.3.3.12 Feature-List-ID AVP

The syntax of this A VP is defined in 3GPP TS 29.229 [5]. For this release, the Feature-List-ID A VP value shall be set to 1.

5.3.3.13 Feature-List AVP

The syntax of this AVP is defined in 3GPP TS 29.229 [5]. A null value indicates that there is no feature used by the application.

NOTE: There is no feature defined for this release.

5.3.3.14 SM-Delivery-Outcome

The SM-Delivery-Outcome AVP is of type Grouped. This AVP contains the result of the SM delivery.

AVP format:

SM-Delivery-Outcome ::= <A VP header: 3316 10415>

[MME-SM-Delivery-Outcome]

[MSC-SM-Delivery-Outcome]

[SGSN-SM-Delivery-Outcome]

[IP-SM-GW-SM-Delivery-Outcome]

*[AVP]

5.3.3.15 MME-SM-Delivery-Outcome

The MME-Delivery-Outcome AVP is of type grouped and shall indicate the outcome of the SM delivery for setting the message waiting data in the HSS when the SM delivery is with an MME.

AVP format:

MME-SM-Delivery-Outcome ::= <A VP header: 3317 10415>>

[SM-Delivery-Cause]

[Absent-User-Diagnostic-SM]

5.3.3.16 MSC-SM-Delivery-Outcome

The MSC-Delivery-Outcome AVP is of type grouped and shall indicate the outcome of the SM delivery for setting the message waiting data in the HSS when the SM delivery is with an MSC.

AVP format:

MSC-SM-Delivery-Outcome ::= <A VP header: 3318 10415>

[SM-Delivery-Cause]

[Absent-User-Diagnostic-SM]

5.3.3.17 SGSN-SM-Delivery-Outcome

The MSC-MME-Delivery-Outcome AVP is of type grouped and shall indicate the outcome of the SM delivery for setting the message waiting data in the HSS when the SM delivery is with an SGSN.

AVP format:

SGSN-SM-Delivery-Outcome ::= <A VP header: 3319 10415>

[SM-Delivery-Cause]

[Absent-User-Diagnostic-SM]

5.3.3.18 IP-SM-GW-SM-Delivery-Outcome

The IP-SM-GW-SM-Delivery-Outcome AVP is of type grouped and shall indicate the outcome of the SM delivery for setting the message waiting data when the SM delivery is with an IP-SM-GW. The following values are defined.

AVP format:

```
IP-SM-GW-SM-Delivery-Outcome ::= <AVP header: 3320 10415>
    [ SM-Delivery-Cause ]
    [ Absent-User-Diagnostic-SM ]
```

5.3.3.19 SM-Delivery-Cause

The SM-Delivery-Cause AVP is of type Enumerated and shall indicate the cause of the SMP delivery result. The following values are defined:

- UE_MEMORY_CAPACITY_EXCEEDED (0)
- ABSENT_USER (1)
- SUCCESSFUL_TRANSFER (2)

5.3.3.20 Absent-Subscriber-Diagnostic-SM

The Absent-Subscriber-Diagnostic-SM AVP is of type Integer32 and shall indicate the diagnostic explaining the absence of the subscriber. The values are defined in 3GPP TS 23.040 [3].

5.4 User identity to HSS resolution

The User identity to HSS resolution mechanism enables the SMS-GMSC or SMS Router in the home PLMN or Diameter proxy agents in the home PLMN to find the identity of the HSS that holds the subscriber data for a given user identified by its MSISDN or by its IMSI when multiple and separately addressable HSSs have been deployed in the home PLMN. The resolution mechanism is not required in PLMNs that utilise a single HSS.

This User identity to HSS resolution mechanism may rely on routing capabilities provided by Diameter and be implemented in the home PLMN within dedicated Diameter Agents (Proxy Agents) responsible for determining the HSS identity based on the provided user identity. If this Diameter based implementation is selected by the home PLMN operator, the principles described below shall apply.

When more than one independently addressable HSS are deployed in the home PLMN, each SMS-GMSC or SMS Router network of the home PLMN shall be configured with the address/identity of a Diameter Agent (Proxy Agent) implementing this resolution mechanism.

Diameter Relay agents and/or Diameter Proxy agents in the home PLMN receiving the Diameter signalling from SMS-GMSC located in other PLMNs shall be configured with the address/identity of a Diameter Agent (Proxy Agent) implementing this resolution mechanism.

To get the HSS identity that holds the subscriber data for a given user identity in the home network, the Diameter request normally destined to the HSS shall be sent to the pre-configured address/identity of a Diameter Proxy agent supporting the User identity to HSS resolution mechanism.

- If this Diameter request is received by a Diameter Redirect Agent, the Diameter Redirect Agent shall determine the HSS identity based on the provided user identity (i.e. MSISDN or IMSI) and shall return a notification of redirection towards the HSS identity, in response to the Diameter request. Multiple HSS identities may be included in the response, as specified in IETF RFC 3588 [4]. In such a case, the requesting Diameter entity shall send the Diameter request to the first HSS identity in the ordered list received in the Diameter response from the Diameter Redirect Agent. If no successful response to the Diameter request is received, the requesting Diameter entity shall send a Diameter request to the next HSS identity in the ordered list. This procedure shall be repeated until a successful response from an HSS is received. After the user identity to HSS resolution, the MME or the SGSN shall store the determined HSS identity/name/Realm and shall use it in further Diameter requests to the same user identity.

- If this Diameter request is received by a Diameter Proxy Agent, the Diameter Proxy Agent shall determine the HSS identity based on the provided user identity (i.e. MSISDN or IMSI) and shall forward the Diameter request directly to the HSS. In this case, the user identity to HSS resolution decision is communicated to the SMS-GMSC in the Origin-Host/Origin-Realm AVPs of the response.

NOTE: Alternatives to the user identity to HSS resolution Diameter based implementation are outside the scope of this specification.

6 Diameter based SGd interface between MME and central SMS functions

6.1 Introduction

The SGd interface enables the transfer of short messages between the MME, the SMS-IWMSC, the SMS-GMSC and the SMS Router as described in 3GPP TS 23.040 [3].

6.2 Procedures description

6.2.1 MO Forward Short Message procedure

6.2.1.1 General

This procedure shall be used between the serving MME and the SMS-IWMSC to forward mobile originated short messages from a mobile user to a Service Centre.

This procedure is used according to the call flows described in 3GPP TS 23.040 [3] clause 10.

Table 6.2.1.1/1 specifies the involved information elements for the request.

Table 6.2.1.1/2 specifies the involved information elements for the answer.

This procedure is mapped to the commands MO-Forward-Short-Message-Request/Answer (OFR/OFA) in the Diameter application specified in subclause 6.3.2.

Table 6.2.1.1/1: MO Forward Short Message Request

Information element name	Mapping to Diameter AVP	Cat.	Description
SMRP DA	SC-Address	M	This information element shall contain the Service Centre address received from the mobile station.
SMRP OA	User-Identifier	M	This information element shall contain: - the IMSI - the MSISDN of the user when it exists.
SMRP UI	SM-RP-UI	M	This information element shall contain the short message transfer protocol data unit
Supported Features	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.

Table 6.2.1.1/2: MO-Forward Short Message Answer

Information element name	Mapping to Diameter AVP	Cat .	Description
Result	Result-Code / Experimental-Result	M	This information element shall contain the result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter Base Protocol. The Experimental-Result AVP shall be used for SGd errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable: <ul style="list-style-type: none"> - Facility Not Supported; - SM Delivery Failure.
SM Delivery Failure Cause	SM-Delivery-Failure-Cause	C	If the Experimental-Result-Code is set to DIAMETER_ERROR_SM_DELIVERY_FAILURE, this information element shall be present and indicate one of the following: <ul style="list-style-type: none"> - unknown Service Centre address; - Service Centre congestion; - invalid Short Message Entity address; - user not Service Centre user. It may be completed with a Diagnostic information element.
SMRP UI	SM-RP-UI	O	If present, this information element shall contain a short message transfer protocol data unit in the message delivery acknowledgement from the SMS-IW MSC to the MME
Supported Features	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.

6.2.1.2 Detailed behaviour of the MME

When the "SMS in MME" feature is applied for the UE, the MME shall make use of this procedure to forward mobile originated short messages received from the UE to the SMS-IW MSC associated to the SMS-SC indicated by the UE. The MME shall check if the SMS related subscription data (e.g. ODB data and Call Barring) allows forwarding the short message.

6.2.1.3 Detailed behaviour of the SMS-IW MSC

When receiving the MO Forward Short Message Request, the SMS-IW MSC shall check if the SMS-SC is known, if it is not, an Experimental-Result-Code set to DIAMETER_ERROR_SM_DELIVERY_FAILURE and a SM Delivery Failure Cause indicating "unknown Service Centre address" shall be returned to the MME.

The SMS IW MSC shall then pass the short message to the addressed SMS-SC.

If the SMS-SC returns a negative acknowledgement, an Experimental-Result-Code set to DIAMETER_ERROR_SM_DELIVERY_FAILURE and a SM Delivery Failure Cause indicating the cause given by the SMC-SC shall be returned to the MME.

If the SMS-SC returns a positive acknowledgement to the SMS IW MSC, a Result-Code set to DIAMETER_SUCCESS shall be returned to the MME.

If a requested facility is not supported, an Experimental-Result-Code set to DIAMETER_ERROR_FACILITY_NOT_SUPPORTED shall be returned.

6.2.2 MT Forward Short Message procedure

6.2.2.1 General

This procedure shall be used between the G-MSC and the serving MME (transiting an SMS Router, if present) to forward mobile terminated short messages.

This procedure is used according to the call flows described in 3GPP TS 23.040 [3] clause 10.

Table 6.2.2.1/1 specifies the involved information elements for the request.

Table 6.2.2.1/2 specifies the involved information elements for the answer.

This procedure is mapped to the commands MT-Forward-Short-Message-Request/Answer (TFR/TFA) in the Diameter application specified in subclause 6.3.2.

Table 6.2.2.1/1: MT Forward Short Message Request

Information element name	Mapping to Diameter AVP	Cat.	Description
SMRP DA	User-Name (See IETF RFC 3588 [6])	M	This information element shall contain an IMSI
SMRP OA	SC-Address	M	This information element shall contain the Service Centre address.
SMRP UI	SM-RP-UI	M	This information element shall contain the short message transfer protocol data unit.
MME Number for MT SMS	MME-Number-for-MT-SMS	M	This Information Element contains the ISDN number of the MME, see 3GPP TS 23.003 [3].
TFR-Flags	TFR-Flags	C	This information element shall contain a bit mask. Bit 0 indicates when set if the Service Centre has more messages to send
SM Delivery Timer	SM-Delivery-Timer	O	This information element, when present, shall indicate the SM Delivery Timer value set in the SMS-GMSC to the IP-SM-GW.
SM Delivery Start Time	SM-Delivery-Start-Time	O	This information element, when present, shall indicate the timestamp (in UTC) at which the SM Delivery Supervision Timer was started in the SMS-GMSC.
Supported Features	Supported-Features (See 3GPP TS 29.229 [5])	O	If present, this information element shall contain the list of features supported by the origin host.

Table 6.2.2.1/2: MT Forward Short Message Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Result	Result-Code / Experimental-Result	M	This information element shall contain the result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter Base Protocol. The Experimental-Result AVP shall be used for SGd errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable: <ul style="list-style-type: none"> - Unknown User; - Absent User; - User busy for MT SMS; - Illegal User; - Illegal Equipment; - SM Delivery Failure.
Absent User Diagnostic SM	Absent-User-Diagnostic-SM	O	This information element may be present when Experimental-Result-Code is set to DIAMETER_ERROR_ABSENT_USER and it shall contain the reason of the absence of the user given by the MME.
SM Delivery Failure Cause	SM-Delivery-Failure-Cause	C	If Experimental-Result-Code is set to DIAMETER_ERROR_SM_DELIVERY_FAILURE, this information element shall be present and indicate one of the following: <ul style="list-style-type: none"> - memory capacity exceeded in the mobile equipment; - UE error; - mobile equipment not equipped to support the mobile terminated short message service. It may be completed with a Diagnostic information element
SMRP UI	SM-RP-UI	O	If present, this information element shall contain a short message transfer protocol data unit in the message delivery acknowledgement from the MME to the Service Centre.
Supported Features	Supported-Features (See 3GPP TS 29.229 [5])	O	If present, this information element shall contain the list of features supported by the origin host.

6.2.2.2 Detailed behaviour of the MME

When receiving a MT Forward Short Message Request, the MME shall check if the IMSI is known,

If it is not known, an Experimental-Result-Code set to DIAMETER_ERROR_USER_UNKNOWN shall be returned.

The MME shall attempt to deliver the short message to the UE.

If the delivery of the short message to the UE is successful, the MME shall return a Result-Code set to DIAMETER_SUCCESS.

If the UE is not reachable, the MME shall set the MNRF flag and shall return an Experimental-Result-Code set to DIAMETER_ERROR_ABSENT_USER.

If the delivery of the mobile terminated short message failed because of memory capacity exceeded or UE error or UE not SM equipped, the MME shall return an Experimental-Result-Code set to DIAMETER_ERROR_SM_DELIVERY_FAILURE complemented with a SM Delivery Failure Cause indication.

If a requested facility is not supported, the MME shall return an Experimental-Result-Code set to DIAMETER_ERROR_FACILITY_NOT_SUPPORTED.

If the user is busy for MT SMS, i.e. the mobile terminated short message transfer cannot be completed because:

- another mobile terminated short message transfer is going on and the delivery node does not support message buffering; or
- another mobile terminated short message transfer is going on and it is not possible to buffer the message for later delivery; or

- the message was buffered but it is not possible to deliver the message before the expiry of the buffering time defined in 3GPP TS 23.040 [3],

the MME shall return an Experimental-Result-Code set to DIAMETER_ERROR_USER_BUSY_FOR_MT_SMS.

If the delivery of the mobile terminated short message failed because the mobile station failed authentication, the MME shall return an Experimental-Result-Code set to DIAMETER_ERROR_ILLEGAL_USER.

If the delivery of the mobile terminated short message failed because an IMEI check failed, i.e. the IMEI was blacklisted or not white-listed, the MME shall return an Experimental-Result-Code set to DIAMETER_ERROR_ILLEGAL_EQUIPMENT.

6.2.2.3 Detailed behaviour of the SMS-GMSC

The SMS-GMSC shall make use of this procedure over the SGd interface for the delivery of a MT short message when it has selected the serving node of which it obtained the Diameter Identity from the answer of the Send Routing Info for SM procedure.

NOTE: The SMS-GMSC is not aware that the MT Forward Short Message Request may be routed to a SMS router.

6.2.2.4 Detailed behaviour of the SMS-Router

When the SMS router has received a MT Forward Short Message from the SMS-GMSC and the SMS Router has selected the MME for delivery, the SMS Router shall forward it to the MME.

When a MT Forward Short Message Answer is received from the MME, the SMS Router shall forward it to the SMS-GMSC.

6.3 Protocol specification

6.3.1 Routing considerations

6.3.1.1 Routing for MO Forward SM messages:

This clause specifies the use of the Diameter routing AVPs Destination-Realm and Destination-Host over the SGd interface for the Diameter command requests from the MME (i.e. for the MO forward SM procedure).

If the MME, from the SMS-SC E164 number received from the UE, can obtain the address/name of the SMS-IWMSC and the associated home network domain name (e.g. by local configuration), both the Destination-Realm and Destination-Host AVPs shall be present in the request.

If the MME, from the SMS-SC E164 number received from the UE, can only obtain the MCC/MNC values of the PLMN to which the SMS-SC belongs, the MME shall use them to build the MCC/MNC based network domain as described in subclause 19.2 of 3GPP TS 23.003 [16] and include it in the Destination-Realm AVP of the request. The request shall then be routed to the next Diameter node.

If the MME cannot obtain the MCC/MNC values from the SMS-SC E164 number, the MME shall forward the request to a Diameter node within the same PLMN, the Destination Realm content being left to the PLMN operator choice. Then:

- if a Diameter node in the routing path inside the PLMN of the MME can obtain the MCC/MNC values of the PLMN to which the SMS-SC belongs,
- it shall use them to build the MCC/MNC based network domain as described in subclause 19.2 of 3GPP TS 23.003 [16] and include it in the Destination-Realm AVP of the request. The request shall then be routed to the next Diameter node.

If the MCC/MNC values of the PLMN to which the SMS-SC belongs cannot be obtained in the PLMN of the MME, the request shall be replaced in the PLMN of the MME by an equivalent request routed through a MAP interface (e.g. via an IWF).

NOTE 1: The inter PLMN routing principle is to reuse the routing based on a MCC/MNC based domain name as used by other Diameter applications such as S6a/d. It is assumed that obtaining the relevant MCC/MNC values from the E164 number of the SMS-SC can be achieved in the PLMN which the MME belongs to. Otherwise a MAP based routing is used. This routing principle may be completed with other routing solutions in the future.

Consequently, the Destination-Host AVP is declared as optional in the ABNF for all requests initiated by an MME.

6.3.1.2 Routing for MT Forward SM messages:

This clause specifies the use of the Diameter routing AVPs Destination-Realm and Destination-Host for the Diameter command requests from the SMS-GMSC or the SMS Router (i.e. for the MT forward SM procedure).

- if the SMS-GMSC has received the Diameter address/name of an MME in the answer to its interrogation to the HSS/HLR for retrieving routing information and if it selects this serving node, it shall use it to populate the Destination-Realm and Destination-Host AVPs.
- If the SMS Router has received the Diameter address/name of the MME in the answer to its interrogation to the HSS/HLR for retrieving routing information and if it selects this serving node, it shall use this Diameter address/name to populate the Destination-Realm and Destination-Host AVPs.

Consequently, the Destination-Host AVP is declared as mandatory in the ABNF for all requests initiated by an SMS-GMSC or a SMS router.

6.3.2 Commands

6.3.2.1 Introduction

This section defines the Command code values and related ABNF for each command described for the SGd interface.

6.3.2.2 Command-Code values

This section defines the Command-Code values for the SGd interface application as allocated by IANA in the IETF RFC 5516 [8].

Every command is defined by means of the ABNF syntax IETF RFC 2234 [6], according to the rules in IETF RFC 3588 [7]. In the case, the definition and use of an AVP is not specified in this document, the guidelines in IETF RFC 3588 [7] shall apply.

NOTE: For this release, the Vendor-Specific-Application-ID is included as an optional AVP in all commands in order to ensure interoperability with diameter agents following a strict implementation of IETF RFC 3588 [7], by which messages not including this AVP will be rejected. IETF RFC 3588 [7] indicates that the AVP shall be present in all proxiable commands, such as those specified here, despite that the contents of this AVP are redundant since the Application ID is already present in the command header. This AVP may be removed in subsequent revisions of this specification, once the diameter base protocol is updated accordingly.

The following Command Codes are defined in this specification:

Table 6.3.2.2/1: Command-Code values for SGd

Command-Name	Abbreviation	Code	Section
MO-Forward-Short-Message Request	OFR	8388645	6.3.2.3
MO-Forward-Short-Message Answer	OFA	8388645	6.3.2.4
MT-Forward-Short-Message Request	TFR	8388646	6.3.2.5
MT-Forward-Short-Message Answer	TFA	8388646	6.3.2.6

For these commands, the Application-ID field shall be set to 16777313 (application identifier of the SGd interface application, allocated by IANA).

6.3.2.3 MO-Forward-Short-Message-Request (OFR) Command

The MO-Forward-Short-Message-Request (OFR) command, indicated by the Command-Code field set to 8388645 and the "R" bit set in the Command Flags field, is sent from MME to SMS-IW MSC.

Message Format

```
<MO-Forward-Short-Message-Request> ::= <Diameter Header: 8388645, REQ, PXY, 16777313>
    <Session-Id>
    [ Vendor-Specific-Application-Id ]
    { Auth-Session-State }
    { Origin-Host }
    { Origin-Realm }
    [ Destination-Host ]
    { Destination-Realm }
    { SC-Address }
    *[ Supported-Features ]
    { User-Identifier }
    { SM-RP-UI }
    *[ A VP ]
    *[ Proxy-Info ]
    *[ Route-Record ]
```

6.3.2.4 MO-Forward-Short-Message-Answer (OFA) Command

The MO-Forward-Short-Message-Answer Command (OFA) command, indicated by the Command-Code field set to 8388645 and the 'R' bit cleared in the Command Flags field, is sent from SMS-IW MSC to MME.

Message Format

```
<MO-Forward-Short-Message-Answer> ::= <Diameter Header: 8388645, PXY, 16777313>
    <Session-Id>
    [ Vendor-Specific-Application-Id ]
    [ Result-Code ]
    [ Experimental-Result ]
    { Auth-Session-State }
    { Origin-Host }
    { Origin-Realm }
    *[ Supported-Features ]
    [ SM-Delivery - Failure-Cause ]
    [ SM-RP-UI ]
    *[ A VP ]
    *[ Failed-A VP ]
    *[ Proxy-Info ]
    *[ Route-Record ]
```

6.3.2.5 MT-Forward-Short-Message-Request (TFR) Command

The MT-Forward-Short-Message-Request (TFR) command, indicated by the Command-Code field set to 8388646 and the "R" bit set in the Command Flags field, is sent from SMS-GMSC to MME (transiting an SMS Router, if present).

Message Format

```
<MT-Forward-Short-Message-Request> ::= <Diameter Header: 8388646, REQ, PXY, 16777313>
    <Session-Id>
    [ Vendor-Specific-Application-Id ]
    { Auth-Session-State }
    { Origin-Host }
    { Origin-Realm }
    [ Destination-Host ]
    { Destination-Realm }
    { User-Name }
```

```

*[ Supported-Features ]
{ SC-Address }
{ SM-RP-UI }
[ MME-Number-for-MT-SMS ]
[ TFR-Flags ]
[ SM-Delivery-Timer ]
[ SM-Delivery-Start-Time ]
*[ A VP ]
*[ Proxy-Info ]
*[ Route-Record ]

```

6.3.2.6 MT-Forward-Short-Message-Answer (TFA) Command

The MT-Forward-Short-Message-Answer Command (TFA) command, indicated by the Command-Code field set to 8388646 and the 'R' bit cleared in the Command Flags field, is sent from MME to SMS-GMSC (transiting an SMS Router, if present).

Message Format

```

< MT-Forward-Short-Message-Answer > ::= < Diameter Header: 8388646, PXY, 16777313 >
    < Session-Id >
    [ Vendor-Specific-Application-Id ]
    [ Result-Code ]
    [ Experimental-Result ]
    { Auth-Session-State }
    { Origin-Host }
    { Origin-Realm }
    *[ Supported-Features ]
    [ Absent-User-Diagnostic-SM ]
    [ SM-Delivery-Failure-Cause ]
    [ SM-RP-UI ]
    *[ A VP ]
    *[ Failed-A VP ]
    *[ Proxy-Info ]
    *[ Route-Record ]

```

6.3.3 AVPs

6.3.3.1 General

The following table specifies the Diameter AVPs defined for the SGd interface protocol, their AVP Code values, types, possible flag values and whether or not the AVP may be encrypted. The Vendor-ID header of all AVPs defined in this specification shall be set to 3GPP (10415).

For all AVPs which contain bit masks and are of the type Unsigned32, e.g., TFR-Flags, bit 0 shall be the least significant bit. For example, to get the value of bit 0, a bit mask of 0x0001 should be used.

Table 6.3.3.1/1: SGd specific Diameter AVPs

Attribute Name	AVP Code	Section defined	Value Type	AVP Flag rules				May Encr.
				Must	May	Should not	Must not	
SC-Address	3300	6.3.3.2	OctetString	M, V				No
SM-RP-UI	3301	6.3.3.3	OctetString	M, V				No
TFR-Flags	3302	6.3.3.4	Unsigned32	M, V				No
SM-Delivery-Failure-Cause	3303	6.3.3.5	Grouped	M, V				No
SM-Enumerated-Delivery-Failure-Cause	3304	6.3.3.6	Enumerated	M, V				No
SM-Diagnostic-Info	3305	6.3.3.7	OctetString	M, V				No
SM-Delivery-Timer	3306	6.3.3.10	Unsigned32	M, V				No
SM-Delivery-Start-Time	3307	6.3.3.11	Time	M, V				No
NOTE 1: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V" indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see IETF RFC 3588 [4].								
NOTE 2: If the M-bit is set for an AVP and the receiver does not understand the AVP, it shall return a rejection. If the M-bit is not set for an AVP, the receiver shall not return a rejection, whether or not it understands the AVP. If the receiver understands the AVP but the M-bit value does not match with the definition in this table, the receiver shall ignore the M-bit.								

The following table specifies the Diameter AVPs re-used from existing Diameter Applications, including a reference to their respective specifications and when needed, a short description of their use within this interface.

Any other AVPs from existing Diameter Applications, except for the AVPs from Diameter Base Protocol, do not need to be supported. The AVPs from Diameter Base Protocol are not included in table 6.3.3.1/2, but they may be re-used for this interface.

Table 6.3.3.1/2: SGd re-used Diameter AVPs

Attribute Name	Reference	Comments	M-bit
User-Name	IETF RFC 3588 [7]		Must
User-Identifier	3GPP TS 29.336 [15]		
MME-Number-for-MT-SMS	3GPP TS 29.272 [4]		
Absent-User-Diagnostic-SM	3GPP TS 29.338	It is defined for the S6c interface, see subclause 5.3.3.20	
Supported-Features	3GPP TS 29.229 [5]		
Feature-List-ID	3GPP TS 29.229 [5]	See subclause 6.3.3.8	
Feature-List	3GPP TS 29.229 [5]	See subclause 6.3.3.9	
NOTE 1: The M-bit settings for re-used AVPs override those of the defining specifications that are referenced. Values include: "Must set", "Must not set". If the M-bit setting is blank, then the defining specification applies.			
NOTE 2: If the M-bit is set for an AVP and the receiver does not understand the AVP, it shall return a rejection. If the M-bit is not set for an AVP, the receiver shall not return a rejection, whether or not it understands the AVP. If the receiver understands the AVP but the M-bit value does not match with the definition in this table, the receiver shall ignore the M-bit.			

6.3.3.2 SC-Address

The SC-Address AVP is of type UTF8String and it shall contain the E164 number of the SMS-SC, in international number format as described in ITU-T Recommendation E.164 [13].

6.3.3.3 SM-RP-UI

The SM-RP-UI is of type OctetString and it shall contain a short message transfer protocol data unit (TPDU) which is defined in 3GPP TS 23.040 [3] and represents the user data field carried by the short message service relay sub-layer protocol. Its maximum length is of 200 octets.

6.3.3.4 TFR-Flags

The TFR-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 6.3.3.4/1:

Table 6.3.3.4/1: TFR-Flags

Bit	Name	Description
0	More-Messages-To-Send	This bit, when set, shall indicate that the service centre has more short messages to send.
NOTE 1: Bits not defined in this table shall be cleared by the sending entity and discarded by the receiving entity.		

6.3.3.5 SM-Delivery-Failure-Cause

The SM-Delivery-Failure-Cause AVP is of type Grouped. It shall contain information about the cause of the failure of a SM delivery with an optional Diagnostic information.

The AVP format shall conform to:

```
SM-Delivery-Failure-Cause ::= <A VP header: 3304 10415>
    { SM-Enumerated-Delivery-Failure-Cause }
    [ SM-Diagnostic-Info ]
    *[ AVP ]
```

6.3.3.6 SM-Enumerated-Delivery-Failure-Cause

The SM-Enumerated-Delivery-Failure-Cause AVP is of type enumerated and it shall contain the cause of the failure of a SM delivery. The following values are defined:

```
MEMORY_CAPACITY_EXCEEDED (0),
EQUIPMENT_PROTOCOL_ERROR (1),
EQUIPMENT_NOT_SM-EQUIPPED (2),
UNKNOWN_SERVICE_CENTRE (3),
SC-CONGESTION (4),
INVALID_SME-ADDRESS (5),
USER_NOT_SC-USER (6).
```

NOTE: The values of the SM-Enumerated-Delivery-Failure-Cause AVP correspond to the ones for the SM-EnumeratedDeliveryFailureCause parameter in MAP as described in 3GPP TS 29.002[9].

6.3.3.7 SM-Diagnostic-Info

The SM-Diagnostic-Info AVP is of type OctetString and it shall contain a complementary information associated to the SM Delivery Failure cause.

6.3.3.8 Feature-List-ID AVP

The syntax of this AVP is defined in 3GPP TS 29.229 [5]. For this release, the Feature-List-ID AVP value shall be set to 1.

6.3.3.9 Feature-List AVP

The syntax of this AVP is defined in 3GPP TS 29.229 [5]. A null value indicates that there is no feature used by the application.

NOTE: There is no feature defined for this release.

6.3.3.10 SM-Delivery-Timer

The SM-Delivery-Timer is of type Integer and it shall contain the value in seconds of the timer for SM Delivery.

6.3.3.11 SM-Delivery-Start-Time

The SM-Delivery-Start-Time is of type Time and in shall contain the timestamp (in UTC) at which the SM Delivery Supervision Timer was started.

7 Result Codes and Experimental-Result values

7.1 General

This section defines result code values that shall be supported by all Diameter implementations that conform to this specification.

7.2 Success

Result codes that fall within the Success category shall be used to inform a peer that a request has been successfully completed. The Result-Code AVP values defined in Diameter Base Protocol RFC 3588 [7] shall be applied.

7.3 Permanent Failures

7.3.1 General

Errors that fall within the Permanent Failures category shall be used to inform the peer that the request has failed, and should not be attempted again. The Result-Code AVP values defined in Diameter Base Protocol RFC 3588 [7] shall be applied. When one of the result codes defined here is included in a response, it shall be inside an Experimental-Result AVP and the Result-Code AVP shall be absent.

7.3.2 DIAMETER_ERROR_USER_UNKNOWN (5001)

This result code shall be sent by the MME over the SGd interface to indicate that the user identified by the IMSI is unknown.

This result code shall be sent by the SMS-IWMSC over the SGd interface to indicate that the user identified by the MSISDN is unknown.

This result code shall be sent by the HSS or the SMS Router over the S6c interface to indicate that the user identified by the MSISDN is unknown.

7.3.3 DIAMETER_ERROR_ABSENT_USER (5550)

This result code shall be sent by the MME over the SGd interface to indicate that the UE is not reachable.

This result code shall be sent by the HSS or the SMS Router over the S6c interface to indicate that the UE is not reachable.

7.3.4 DIAMETER_ERROR_USER_BUSY_FOR_MT_SMS (5551)

This result code shall be sent by the MME when the user is busy for MT SMS.

7.3.5 DIAMETER_ERROR_FACILITY_NOT_SUPPORTED (5552)

This result code shall be sent to indicate a requested facility is not supported.

NOTE: This code corresponds to the Facility Not Supported MAP error and may be used by an IWF.

7.3.6 DIAMETER_ERROR_ILLEGAL_USER (5553)

This result code shall be sent by the MME to indicate that the delivery of the mobile terminated short message failed because the mobile station failed authentication.

7.3.7 DIAMETER_ERROR_ILLEGAL_EQUIPMENT (5554)

This result code shall be sent by the MME to indicate that the delivery of the mobile terminated short message failed because an IMEI check failed, i.e. the IMEI was blacklisted or not white-listed.

7.3.8 DIAMETER_ERROR_SM_DELIVERY_FAILURE (5555)

This result code shall be sent by the MME or the SMS-IWMSC to indicate that the delivery of the mobile terminated short message failed.

7.3.9 DIAMETER_ERROR_SERVICE_NOT_SUBSCRIBED (5556)

This result code shall be sent by the HSS or the SMS Router over the S6c interface to indicate that the MT SMS Teleservice is not part of the subscription.

7.3.10 DIAMETER_ERROR_SERVICE_BARRED (5557)

This result code shall be sent by the HSS or the SMS Router over the S6c interface to indicate that the MT SMS Teleservice is barred.

This result code shall be sent by the MME to indicate that the delivery of the mobile terminated short message failed because of the barring of the SMS service.

7.3.11 DIAMETER_ERROR_MWD_LIST_FULL (5558)

This result code shall be sent by the HSS over the S6c interface to indicate that the Message Waiting List is full.

7.4 Transient Failures

7.4.1 General

Result codes that fall within the transient failures category shall be used to inform a peer that the request could not be satisfied at the time it was received, but may be able to satisfy the request in the future. The Result-Code A VP values defined in Diameter Base Protocol RFC 3588 [7] shall be applied.

Annex A (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2012	CT#58	CP-120762			TS sent for approval	2.0.0	11.0.0
2013-09	CT#61	CP-130450	0006	1	Correction on Routing for MO SM	11.0.0	11.1.0